FIG. 1

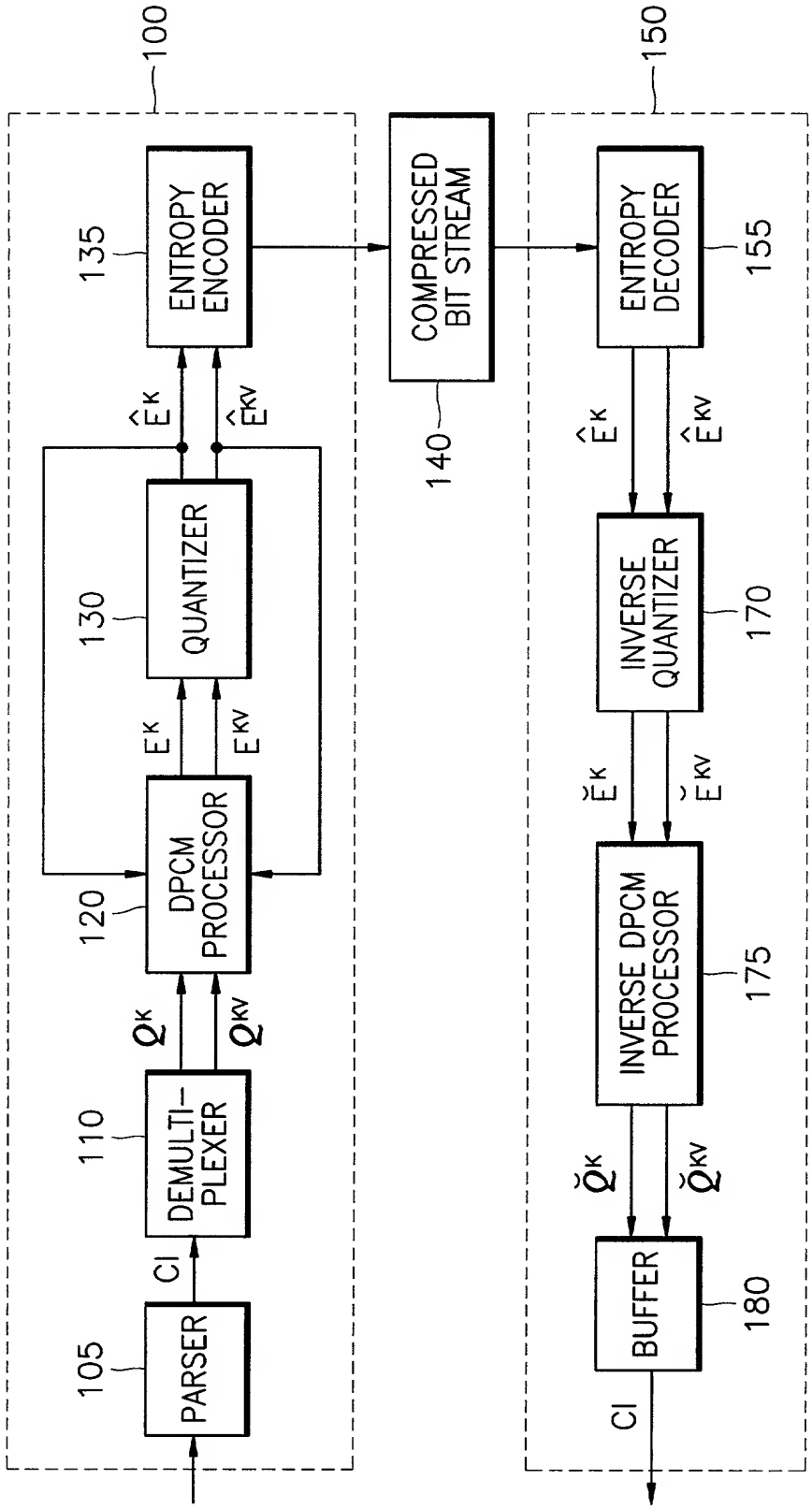

100
150
105
PARSER
CI
110
DEMULTI-PLEXER
120
DPCM PROCESSOR
130
QUANTIZER
135
ENTROPY ENCODER
140
COMPRESSED BIT STREAM
155
ENTROPY DECODER
170
INVERSE QUANTIZER
175
INVERSE DPCM PROCESSOR
180
BUFFER
CI

FIG. 2

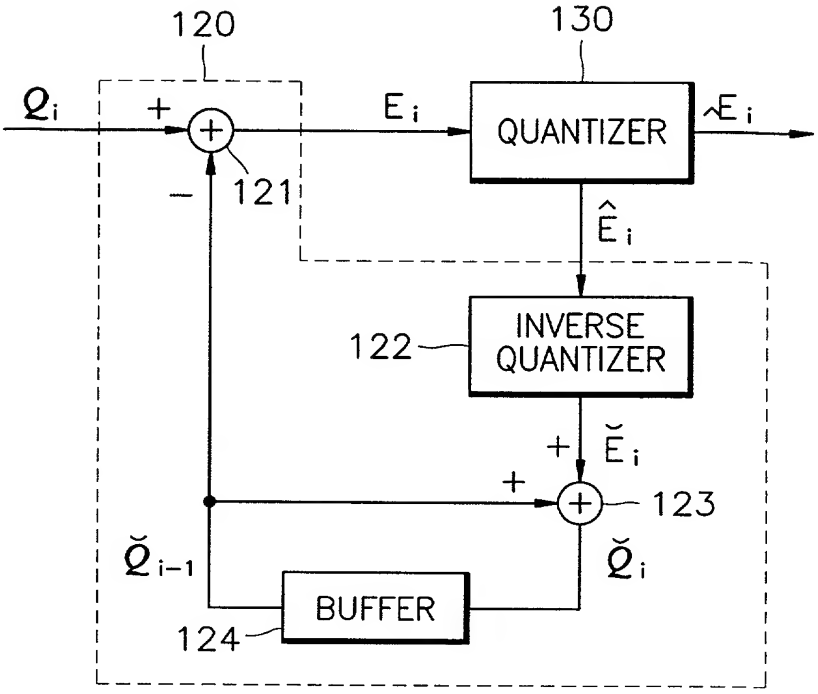

120
130
Q_i
+
E_i
QUANTIZER
$\sim E_i$
121
−
$\hat{E}_i$
122
INVERSE QUANTIZER
+
$\check{E}_i$
+
123
$\check{Q}_{i-1}$
$\check{Q}_i$
BUFFER
124

FIG. 3

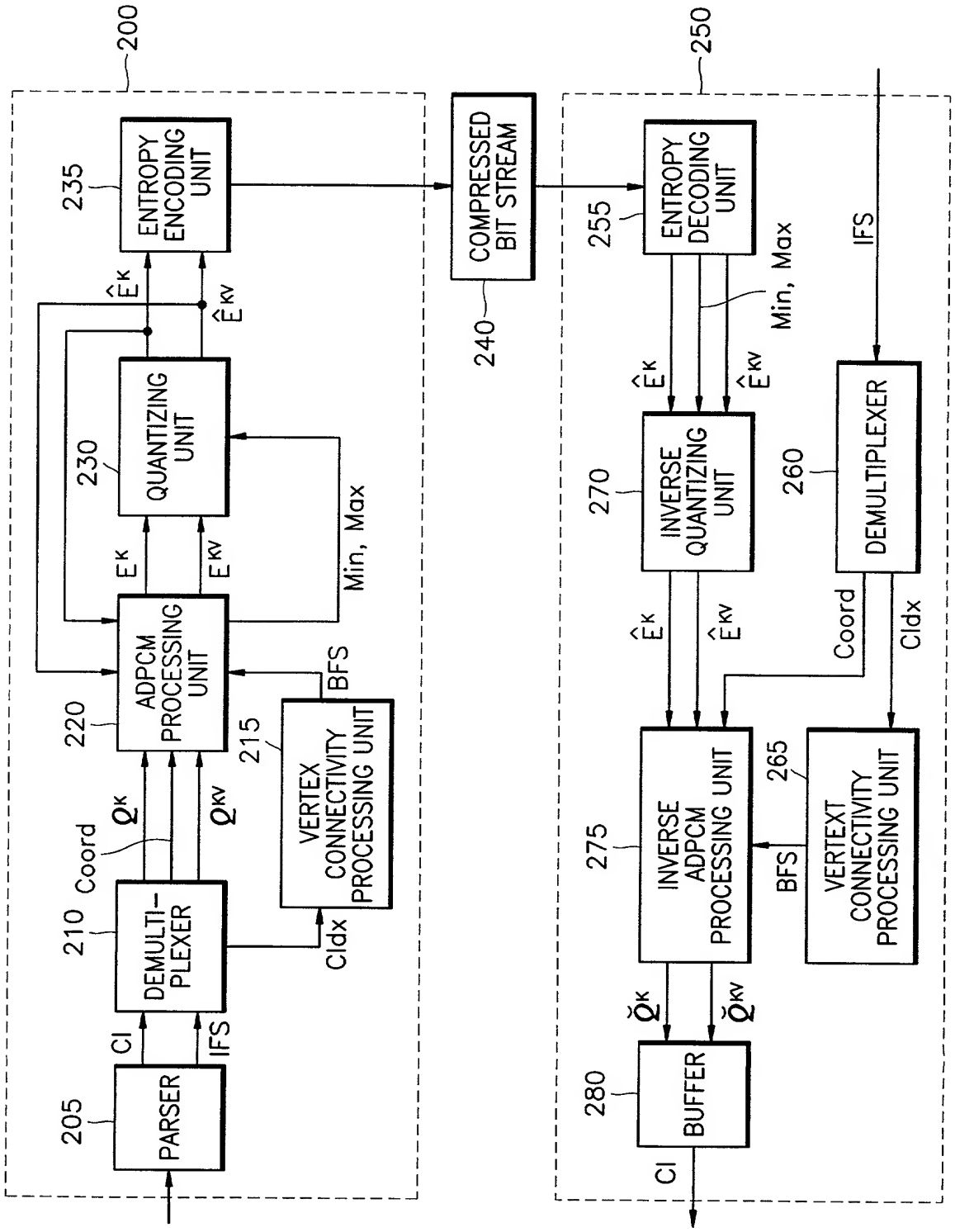

200
250
235
ENTROPY ENCODING UNIT
230
QUANTIZING UNIT
220
ADPCM PROCESSING UNIT
215
VERTEX CONNECTIVITY PROCESSING UNIT
210
DEMULTI-PLEXER
205
PARSER
240
COMPRESSED BIT STREAM
255
ENTROPY DECODING UNIT
270
INVERSE QUANTIZING UNIT
260
DEMULTIPLEXER
275
INVERSE ADPCM PROCESSING UNIT
265
VERTEXT CONNECTIVITY PROCESSING UNIT
280
BUFFER
Min, Max
BFS
Coord
CIdx
CI
IFS

FIG. 4

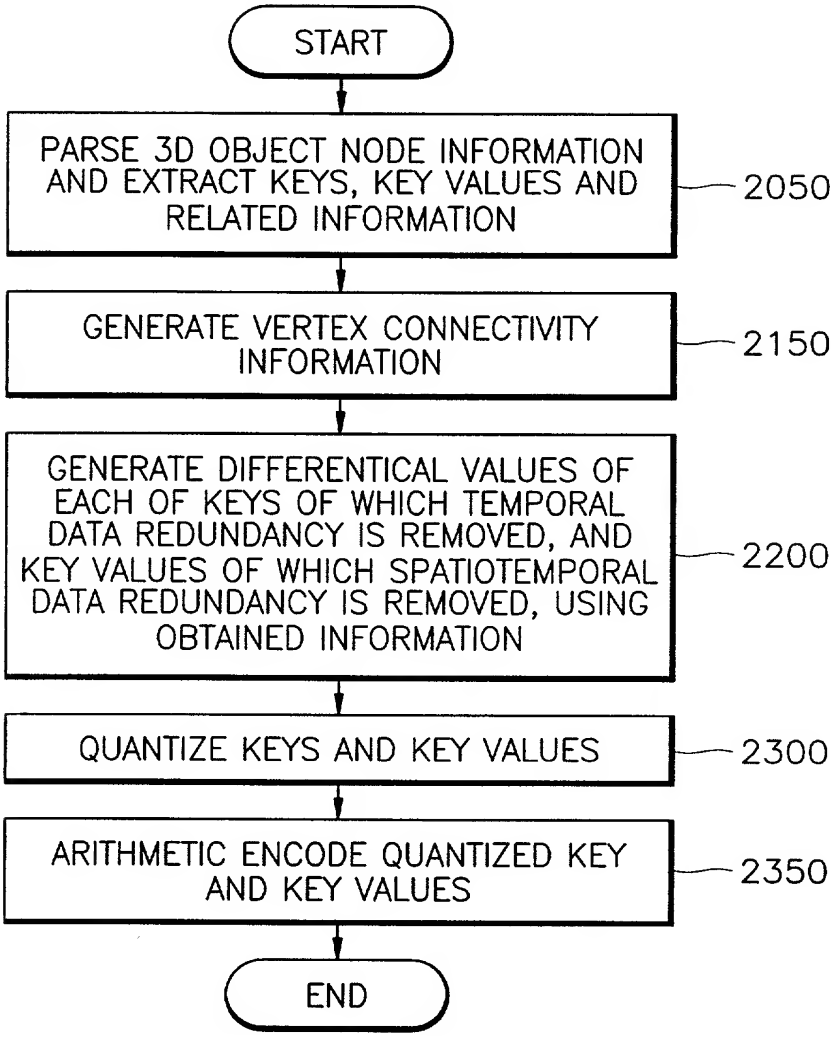

START
PARSE 3D OBJECT NODE INFORMATION AND EXTRACT KEYS, KEY VALUES AND RELATED INFORMATION
2050
GENERATE VERTEX CONNECTIVITY INFORMATION
2150
GENERATE DIFFERENTICAL VALUES OF EACH OF KEYS OF WHICH TEMPORAL DATA REDUNDANCY IS REMOVED, AND KEY VALUES OF WHICH SPATIOTEMPORAL DATA REDUNDANCY IS REMOVED, USING OBTAINED INFORMATION
2200
QUANTIZE KEYS AND KEY VALUES
2300
ARITHMETIC ENCODE QUANTIZED KEY AND KEY VALUES
2350
END

FIG. 5

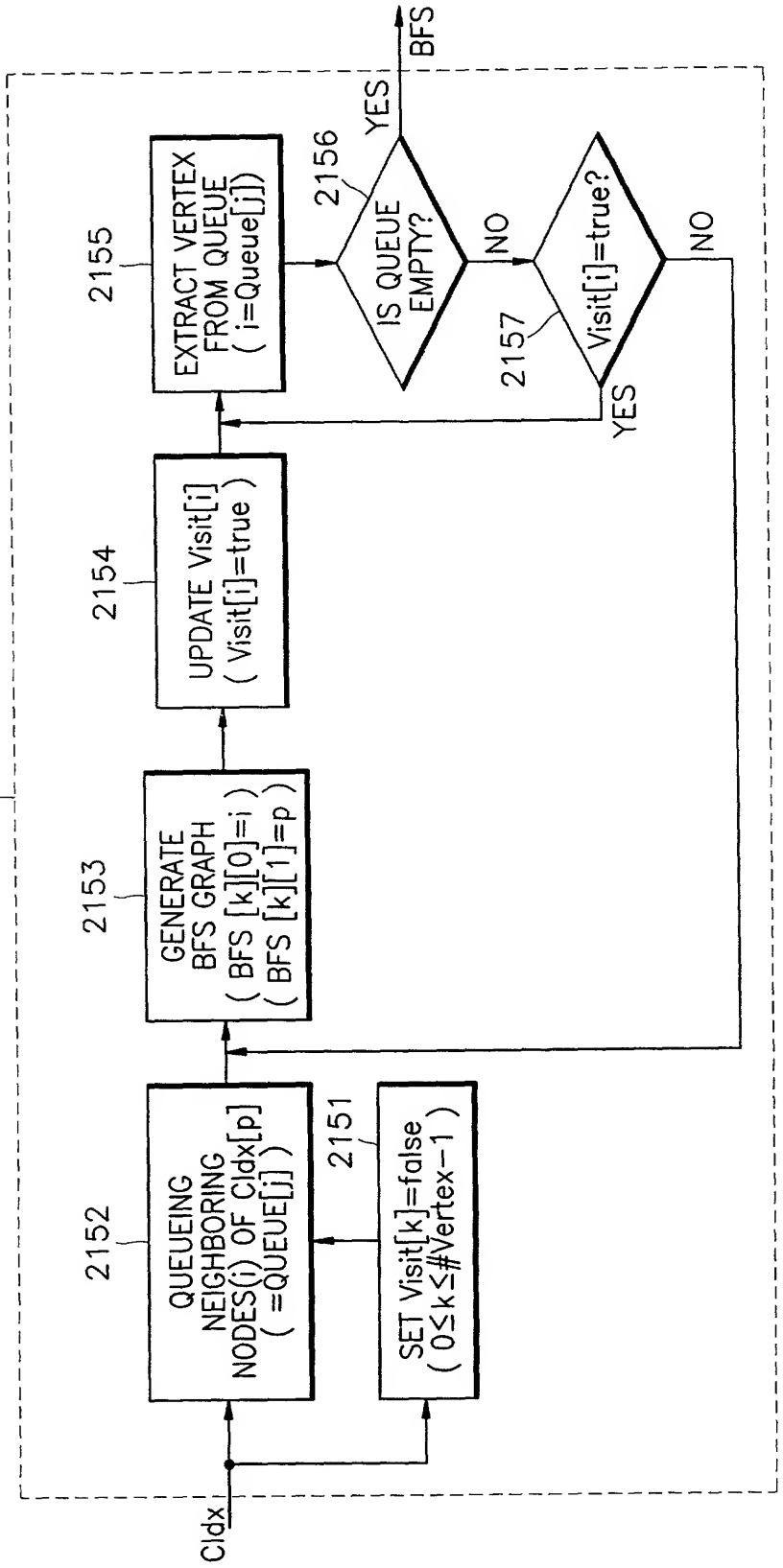

2150
Cldx
2151
SET Visit[k]=false
(0≤k≤#Vertex−1)
2152
QUEUEING
NEIGHBORING
NODES(i) OF Cldx[p]
(=QUEUE[j])
2153
GENERATE
BFS GRAPH
(BFS [k][0]=i)
(BFS [k][1]=p)
2154
UPDATE Visit[i]
(Visit[i]=true)
2155
EXTRACT VERTEX
FROM QUEUE
(i=Queue[j])
2156
IS QUEUE
EMPTY?
YES
BFS
NO
2157
Visit[i]=true?
NO
YES

FIG. 6

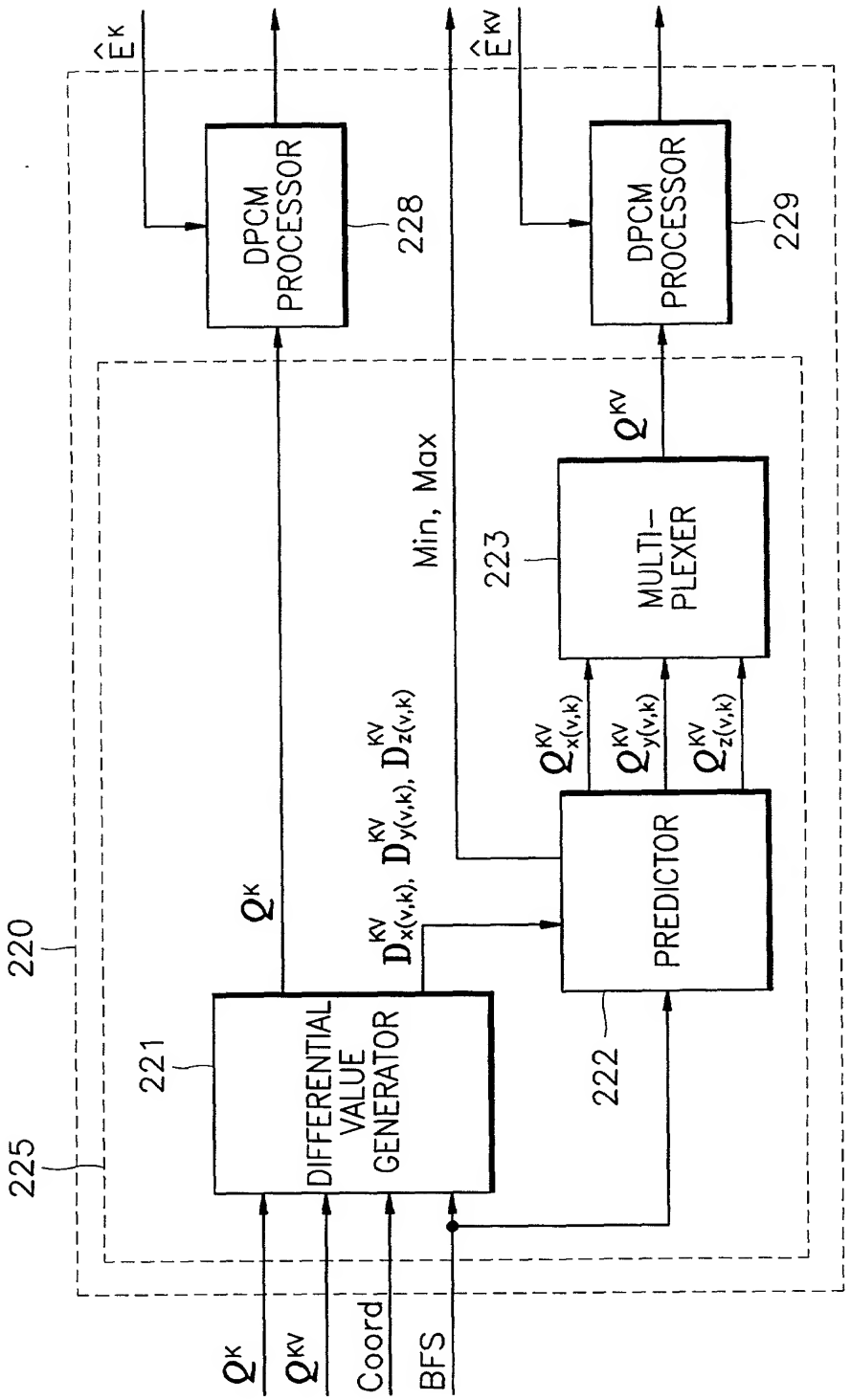

$\hat{E}^K$
$\hat{E}^{KV}$
DPCM PROCESSOR
228
DPCM PROCESSOR
229
Min, Max
Q^{KV}
223
MULTI-PLEXER
$Q^{KV}_{x(v,k)}$
$Q^{KV}_{y(v,k)}$
$Q^{KV}_{z(v,k)}$
Q^K
$D^{KV}_{x(v,k)}$, $D^{KV}_{y(v,k)}$, $D^{KV}_{z(v,k)}$
220
221
DIFFERENTIAL VALUE GENERATOR
PREDICTOR
222
225
Q^K
Q^{KV}
Coord
BFS

FIG. 7

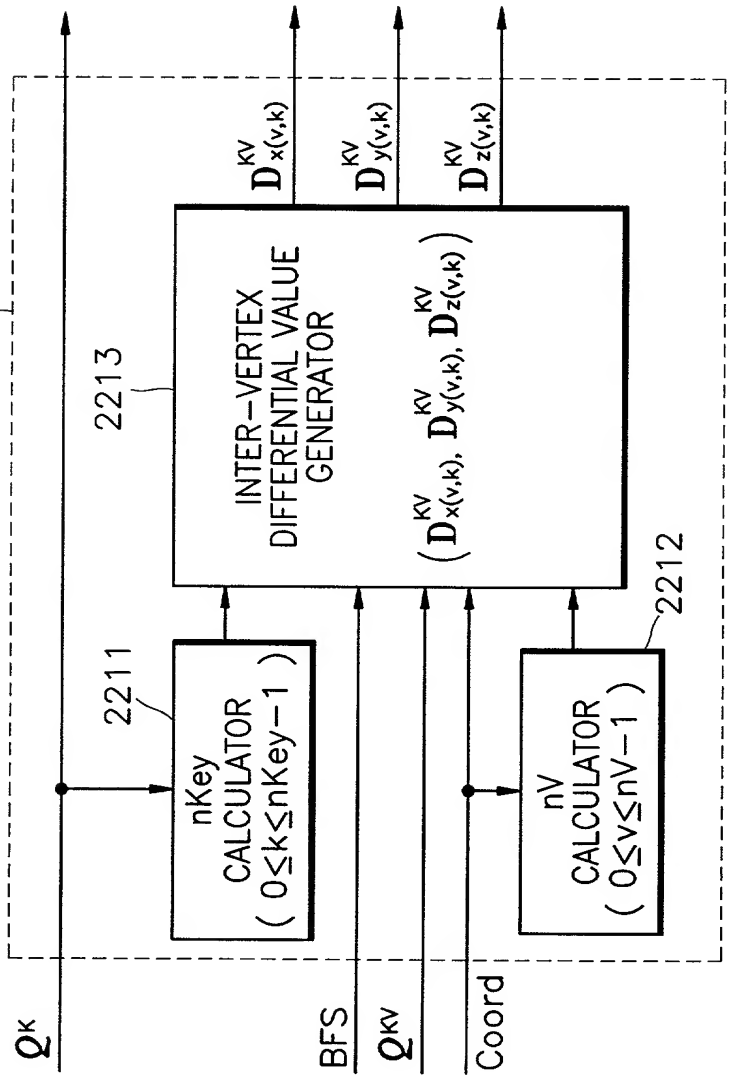

221
2213
INTER-VERTEX DIFFERENTIAL VALUE GENERATOR
$D^{KV}_{x(v,k)}$
$D^{KV}_{y(v,k)}$
$D^{KV}_{z(v,k)}$
$(D^{KV}_{x(v,k)}, D^{KV}_{y(v,k)}, D^{KV}_{z(v,k)})$
2211
nKey CALCULATOR (0≤k≤nKey−1)
2212
nV CALCULATOR (0≤v≤nV−1)
Q^K
BFS
Q^{KV}
Coord

FIG. 8

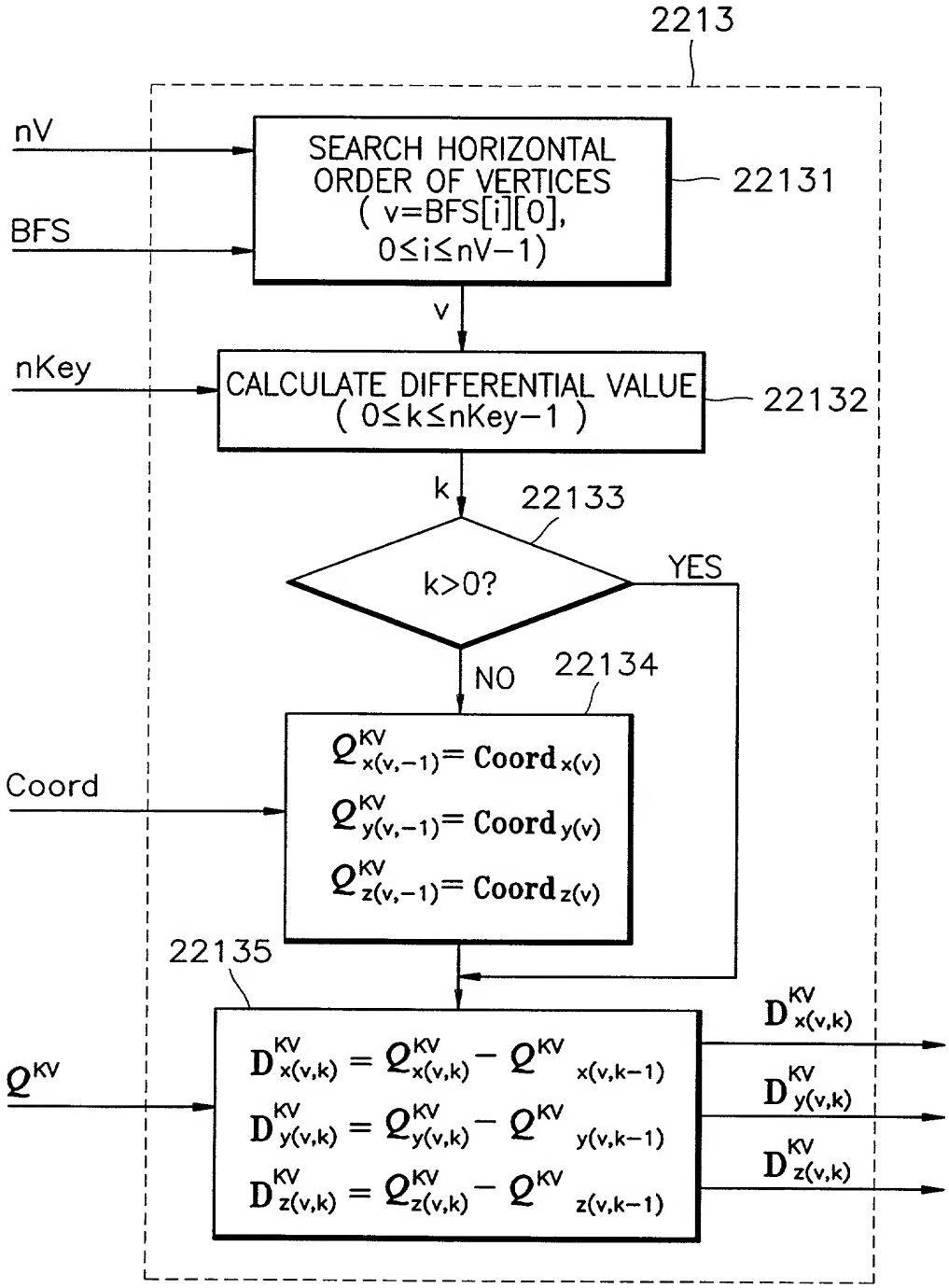

2213
nV
BFS
SEARCH HORIZONTAL ORDER OF VERTICES (v=BFS[i][0], 0≤i≤nV−1)
22131
v
nKey
CALCULATE DIFFERENTIAL VALUE (0≤k≤nKey−1)
22132
k
22133
k>0?
YES
NO
22134
Coord
$Q^{KV}_{x(v,-1)} = Coord_{x(v)}$
$Q^{KV}_{y(v,-1)} = Coord_{y(v)}$
$Q^{KV}_{z(v,-1)} = Coord_{z(v)}$
22135
Q^{KV}
$D^{KV}_{x(v,k)} = Q^{KV}_{x(v,k)} - Q^{KV}_{x(v,k-1)}$
$D^{KV}_{y(v,k)} = Q^{KV}_{y(v,k)} - Q^{KV}_{y(v,k-1)}$
$D^{KV}_{z(v,k)} = Q^{KV}_{z(v,k)} - Q^{KV}_{z(v,k-1)}$
$D^{KV}_{x(v,k)}$
$D^{KV}_{y(v,k)}$
$D^{KV}_{z(v,k)}$

FIG. 9

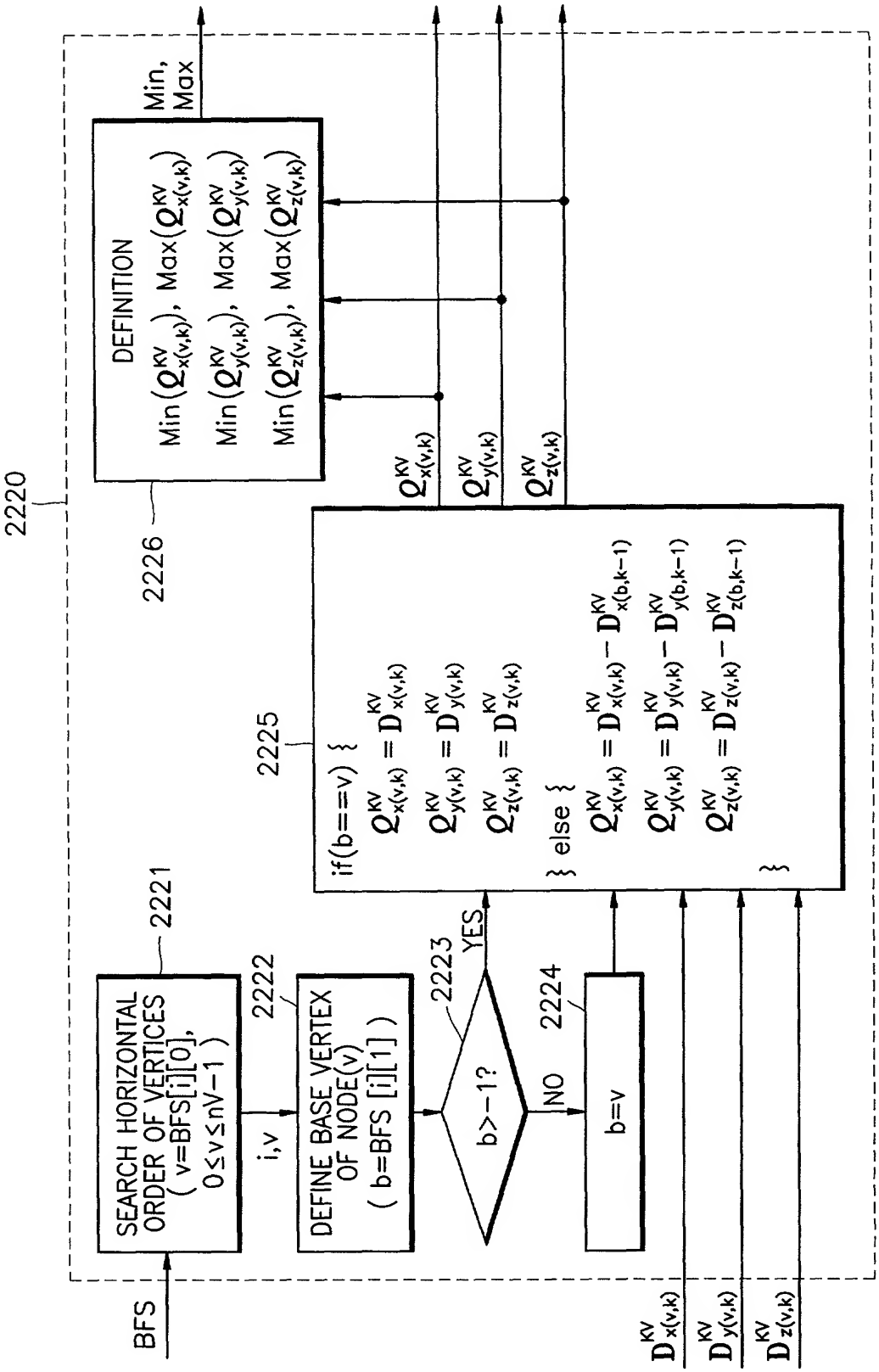

2220
2221
SEARCH HORIZONTAL ORDER OF VERTICES (v=BFS[i][0], 0≤v≤nV−1)
2222
DEFINE BASE VERTEX OF NODE(v) (b=BFS [i][1])
2223
b>−1?
YES
NO
2224
b=v
2225
if(b==v) {
$Q^{KV}_{x(v,k)} = D^{KV}_{x(v,k)}$
$Q^{KV}_{y(v,k)} = D^{KV}_{y(v,k)}$
$Q^{KV}_{z(v,k)} = D^{KV}_{z(v,k)}$
} else {
$Q^{KV}_{x(v,k)} = D^{KV}_{x(v,k)} - D^{KV}_{x(b,k-1)}$
$Q^{KV}_{y(v,k)} = D^{KV}_{y(v,k)} - D^{KV}_{y(b,k-1)}$
$Q^{KV}_{z(v,k)} = D^{KV}_{z(v,k)} - D^{KV}_{z(b,k-1)}$
}
2226
DEFINITION
$\text{Min}(Q^{KV}_{x(v,k)})$, $\text{Max}(Q^{KV}_{x(v,k)})$
$\text{Min}(Q^{KV}_{y(v,k)})$, $\text{Max}(Q^{KV}_{y(v,k)})$
$\text{Min}(Q^{KV}_{z(v,k)})$, $\text{Max}(Q^{KV}_{z(v,k)})$
Min, Max
$Q^{KV}_{x(v,k)}$
$Q^{KV}_{y(v,k)}$
$Q^{KV}_{z(v,k)}$
i,v
BFS
$D^{KV}_{x(v,k)}$
$D^{KV}_{y(v,k)}$
$D^{KV}_{z(v,k)}$

FIG. 10

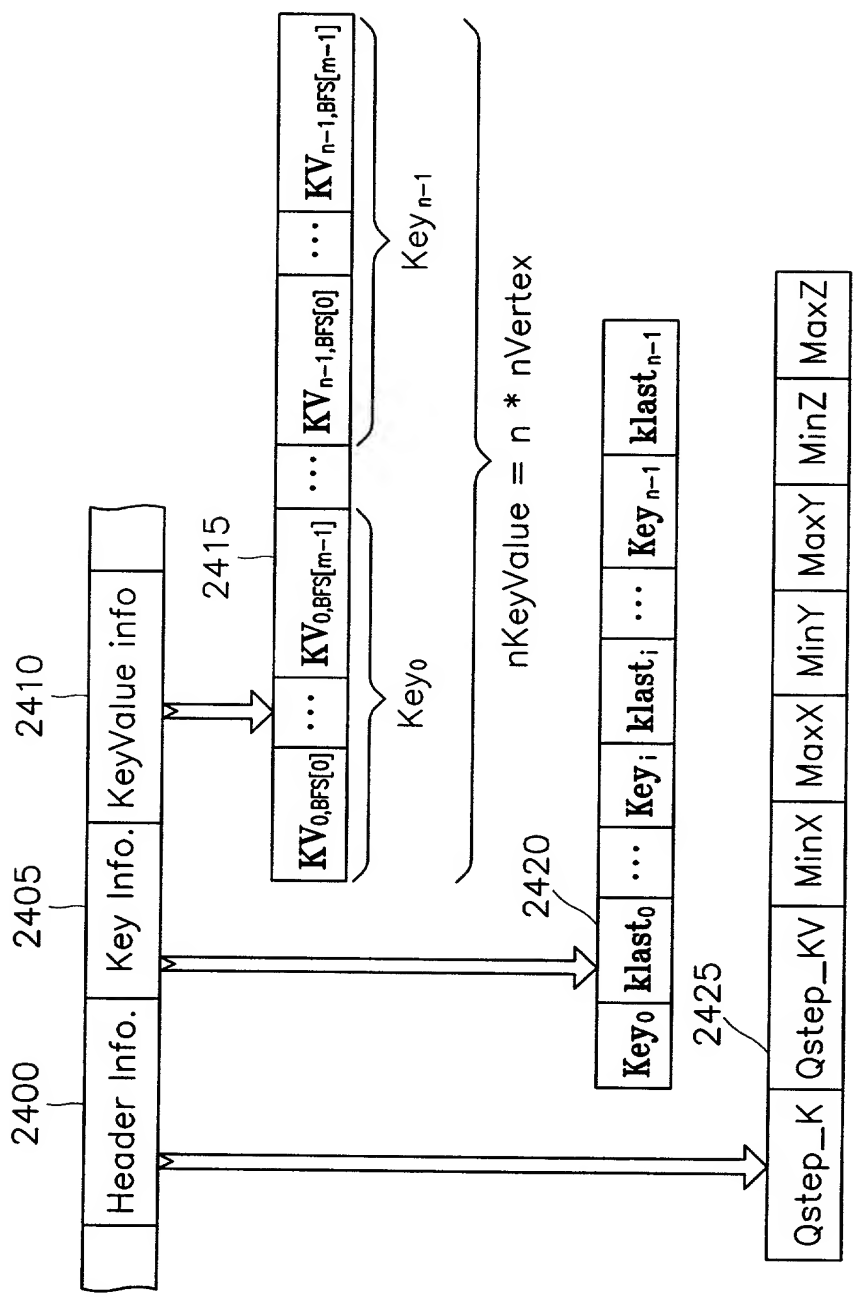

2400
2405
2410
2415
2420
2425
Header Info.
Key Info.
KeyValue info
KV0,BFS[0]
KV0,BFS[m-1]
KVn-1,BFS[0]
KVn-1,BFS[m-1]
Key0
Keyn-1
nKeyValue = n * nVertex
Key0 klast0
Keyi klastj
Keyn-1 klastn-1
Qstep_K
Qstep_KV
MinX
MaxX
MinY
MaxY
MinZ
MaxZ

FIG. 11

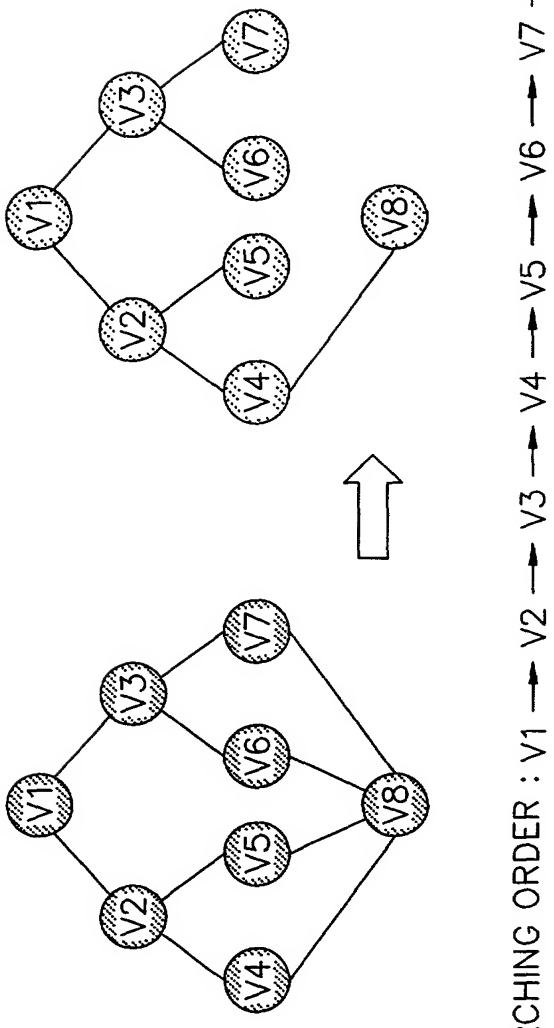

V1
V2
V3
V4
V5
V6
V7
V8
V1
V2
V3
V4
V5
V6
V7
V8
SEARCHING ORDER : V1 → V2 → V3 → V4 → V5 → V6 → V7 → V8

FIG. 12

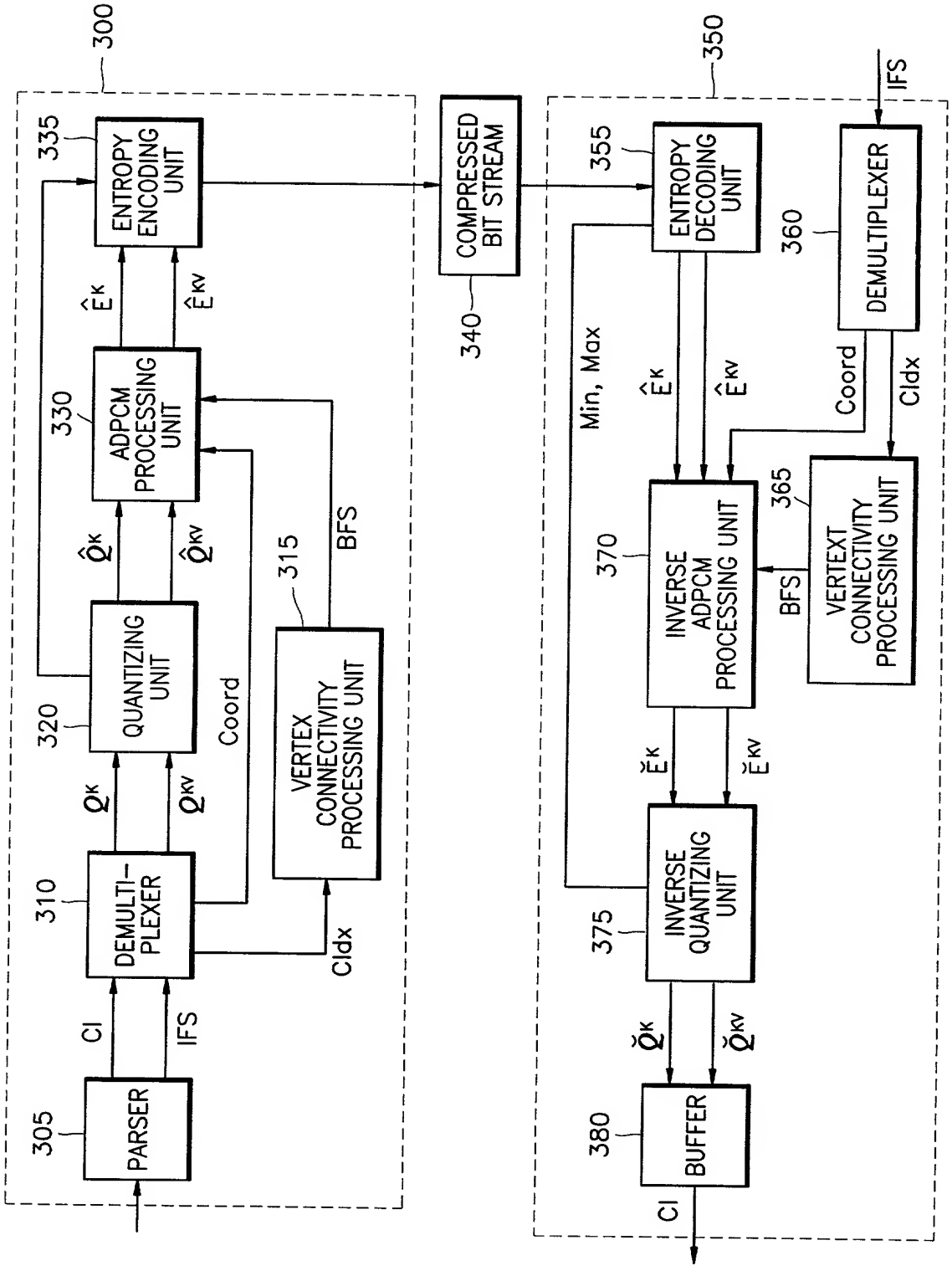

300
305
PARSER
CI
IFS
310
DEMULTI-PLEXER
320
QUANTIZING UNIT
330
ADPCM PROCESSING UNIT
335
ENTROPY ENCODING UNIT
315
VERTEX CONNECTIVITY PROCESSING UNIT
Coord
Cldx
BFS
340
COMPRESSED BIT STREAM
350
355
ENTROPY DECODING UNIT
360
DEMULTIPLEXER
365
VERTEXT CONNECTIVITY PROCESSING UNIT
370
INVERSE ADPCM PROCESSING UNIT
375
INVERSE QUANTIZING UNIT
380
BUFFER
Min, Max

FIG. 13

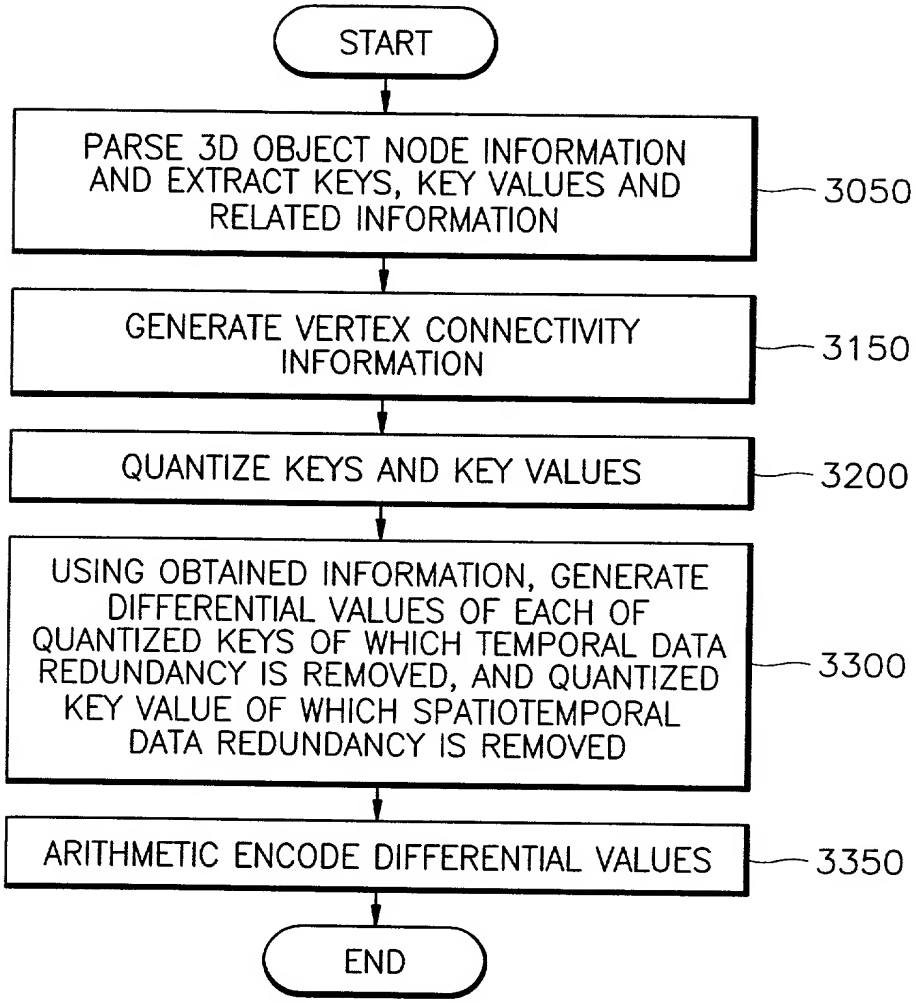

START
PARSE 3D OBJECT NODE INFORMATION AND EXTRACT KEYS, KEY VALUES AND RELATED INFORMATION
3050
GENERATE VERTEX CONNECTIVITY INFORMATION
3150
QUANTIZE KEYS AND KEY VALUES
3200
USING OBTAINED INFORMATION, GENERATE DIFFERENTIAL VALUES OF EACH OF QUANTIZED KEYS OF WHICH TEMPORAL DATA REDUNDANCY IS REMOVED, AND QUANTIZED KEY VALUE OF WHICH SPATIOTEMPORAL DATA REDUNDANCY IS REMOVED
3300
ARITHMETIC ENCODE DIFFERENTIAL VALUES
3350
END

FIG. 14

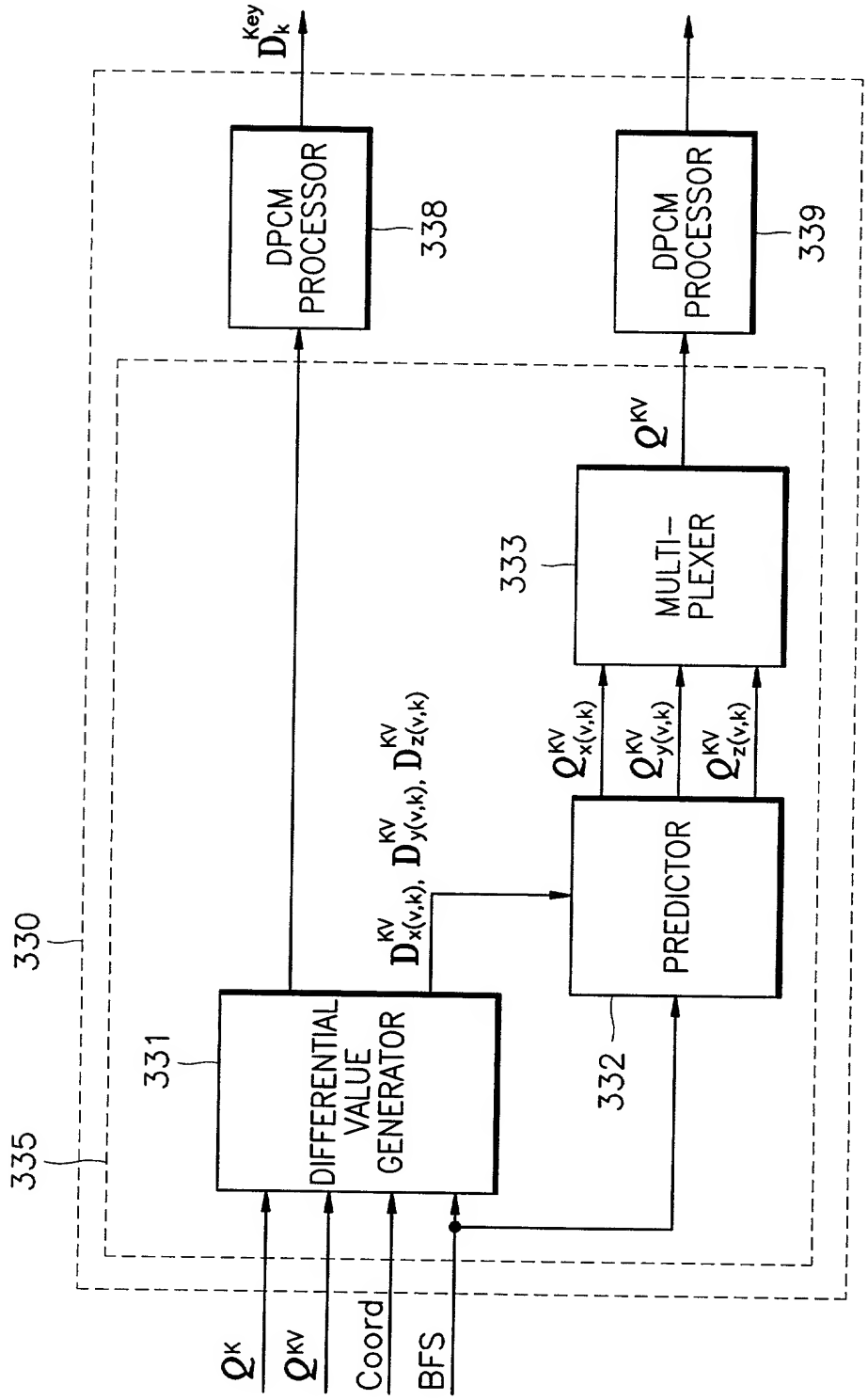

D_k^{Key}
DPCM PROCESSOR
338
DPCM PROCESSOR
339
Q^{KV}
333
MULTI-PLEXER
$Q^{KV}_{x(v,k)}$
$Q^{KV}_{y(v,k)}$
$Q^{KV}_{z(v,k)}$
$D^{KV}_{x(v,k)}$, $D^{KV}_{y(v,k)}$, $D^{KV}_{z(v,k)}$
PREDICTOR
332
330
331
DIFFERENTIAL VALUE GENERATOR
335
Q^K
Q^{KV}
Coord
BFS

FIG. 15

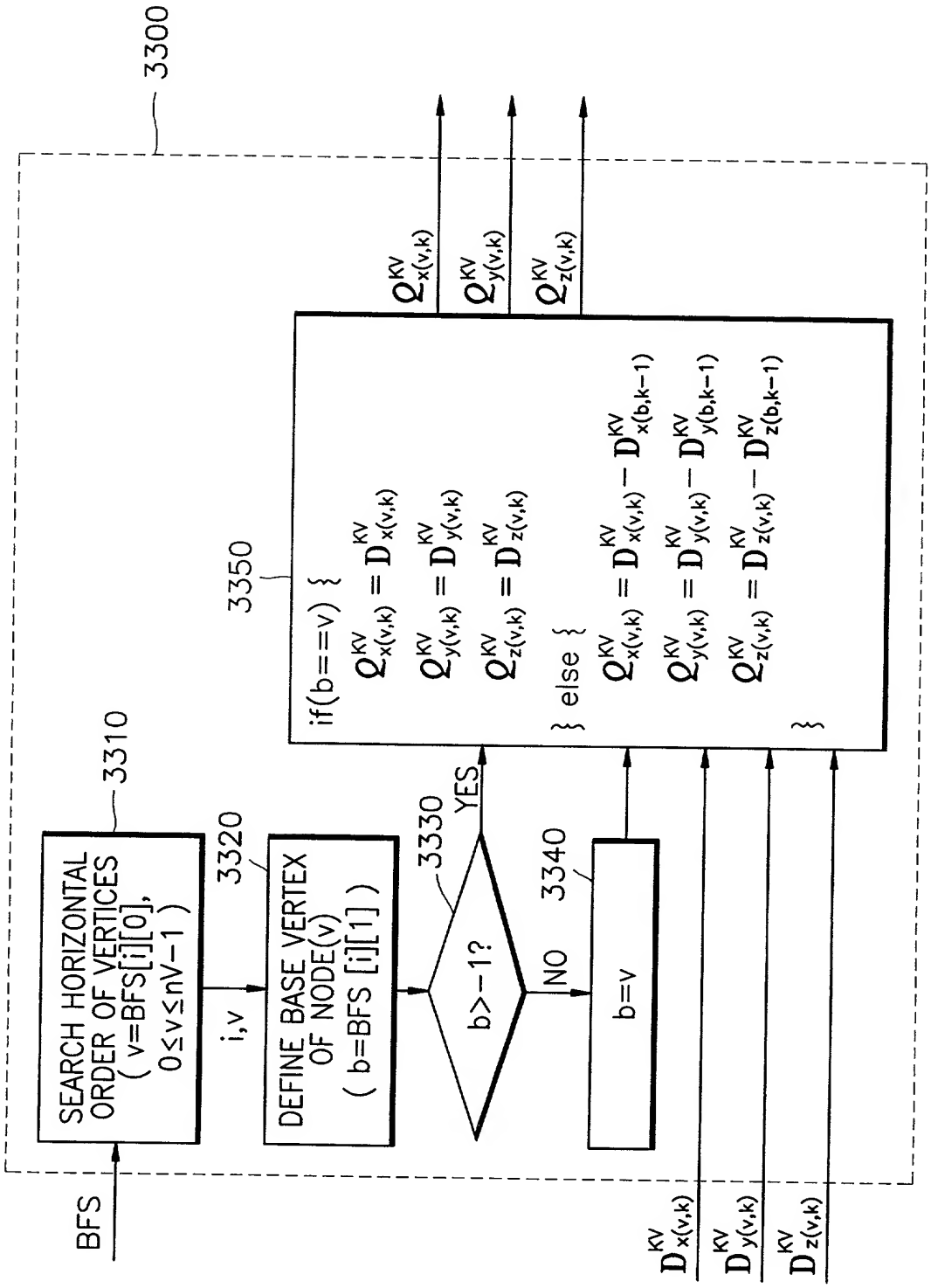

3300
3310
SEARCH HORIZONTAL ORDER OF VERTICES (v=BFS[i][0], 0≤v≤nV−1)
3320
DEFINE BASE VERTEX OF NODE(v) (b=BFS [i][1])
i,v
3330
b>−1?
YES
NO
3340
b=v
3350
if(b==v) {
$Q^{KV}_{x(v,k)} = D^{KV}_{x(v,k)}$
$Q^{KV}_{y(v,k)} = D^{KV}_{y(v,k)}$
$Q^{KV}_{z(v,k)} = D^{KV}_{z(v,k)}$
} else {
$Q^{KV}_{x(v,k)} = D^{KV}_{x(v,k)} - D^{KV}_{x(b,k-1)}$
$Q^{KV}_{y(v,k)} = D^{KV}_{y(v,k)} - D^{KV}_{y(b,k-1)}$
$Q^{KV}_{z(v,k)} = D^{KV}_{z(v,k)} - D^{KV}_{z(b,k-1)}$
}
BFS
$Q^{KV}_{x(v,k)}$
$Q^{KV}_{y(v,k)}$
$Q^{KV}_{z(v,k)}$
$D^{KV}_{x(v,k)}$
$D^{KV}_{y(v,k)}$
$D^{KV}_{z(v,k)}$

FIG. 16

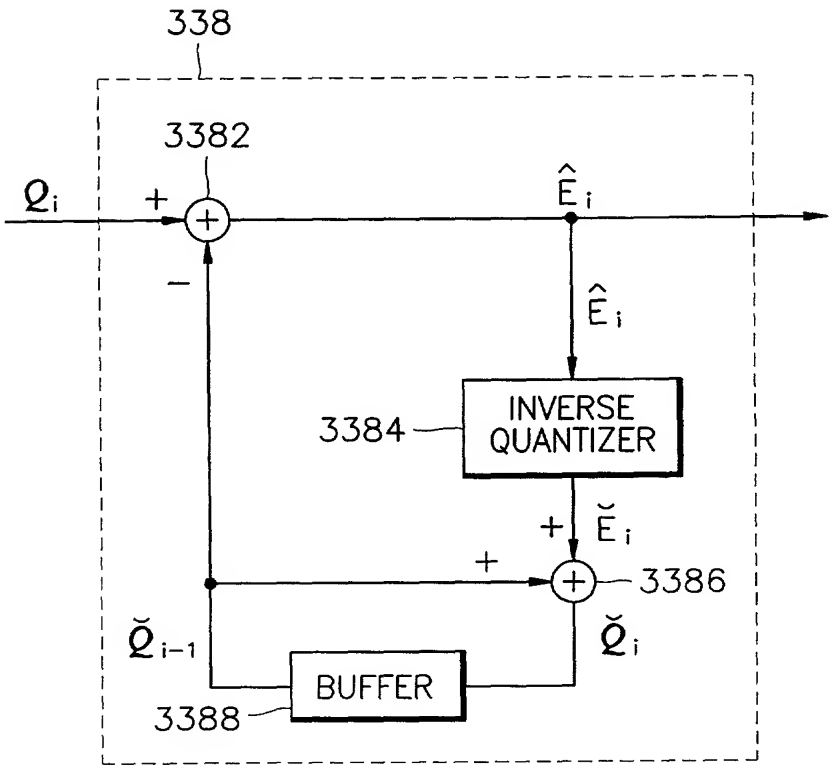

338
3382
Q_i
+
$\hat{E}_i$
−
$\hat{E}_i$
3384
INVERSE QUANTIZER
+
$\breve{E}_i$
+
3386
$\breve{Q}_{i-1}$
$\breve{Q}_i$
BUFFER
3388

FIG. 17

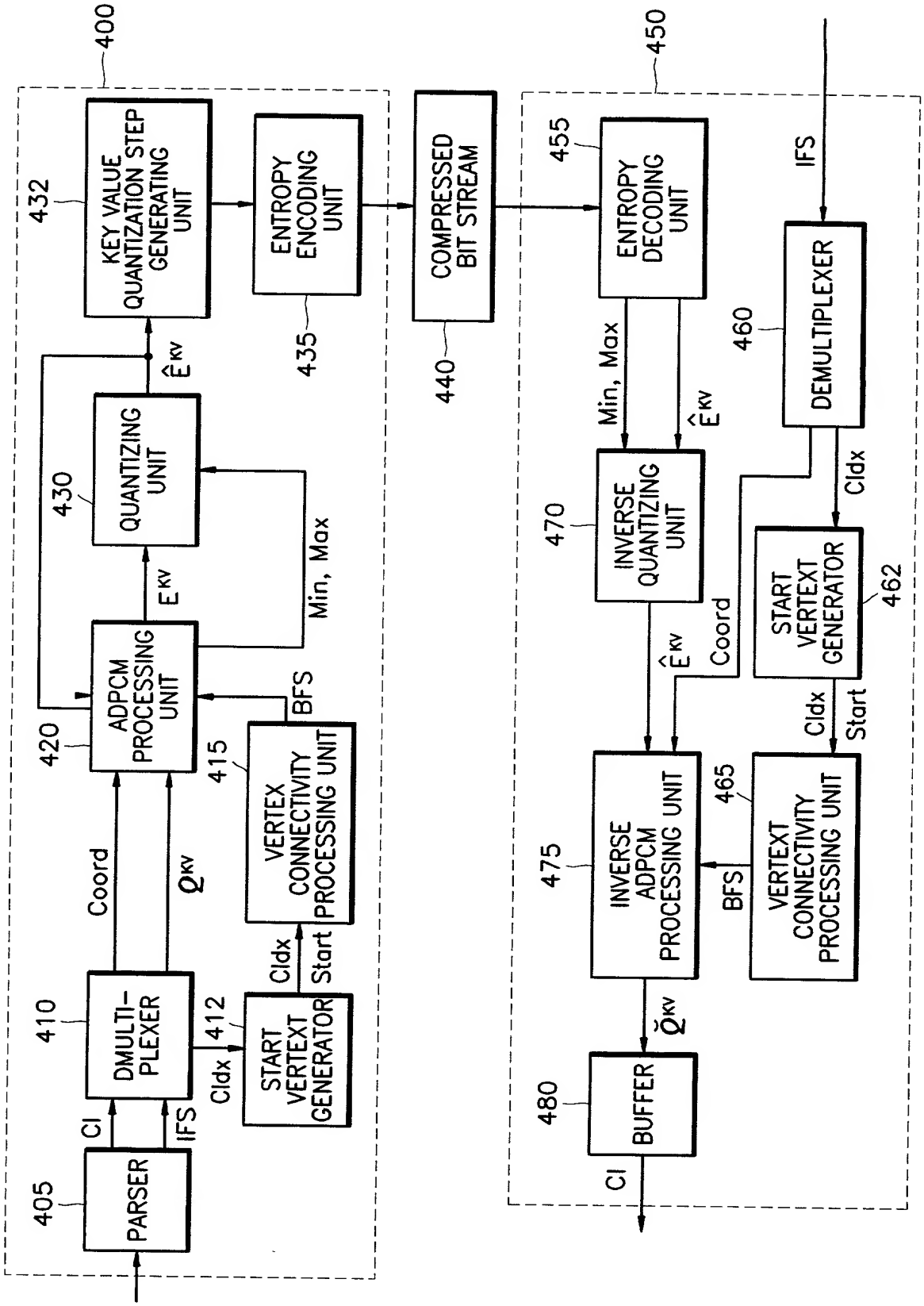

400
450
KEY VALUE QUANTIZATION STEP GENERATING UNIT
432
ENTROPY ENCODING UNIT
435
COMPRESSED BIT STREAM
440
ENTROPY DECODING UNIT
455
IFS
DEMULTIPLEXER
460
QUANTIZING UNIT
430
ADPCM PROCESSING UNIT
420
VERTEX CONNECTIVITY PROCESSING UNIT
415
DMULTI-PLEXER
410
START VERTEXT GENERATOR
412
PARSER
405
INVERSE QUANTIZING UNIT
470
START VERTEXT GENERATOR
462
INVERSE ADPCM PROCESSING UNIT
475
VERTEXT CONNECTIVITY PROCESSING UNIT
465
BUFFER
480
Min, Max
Cldx
Start
BFS
Coord
CI

FIG. 18

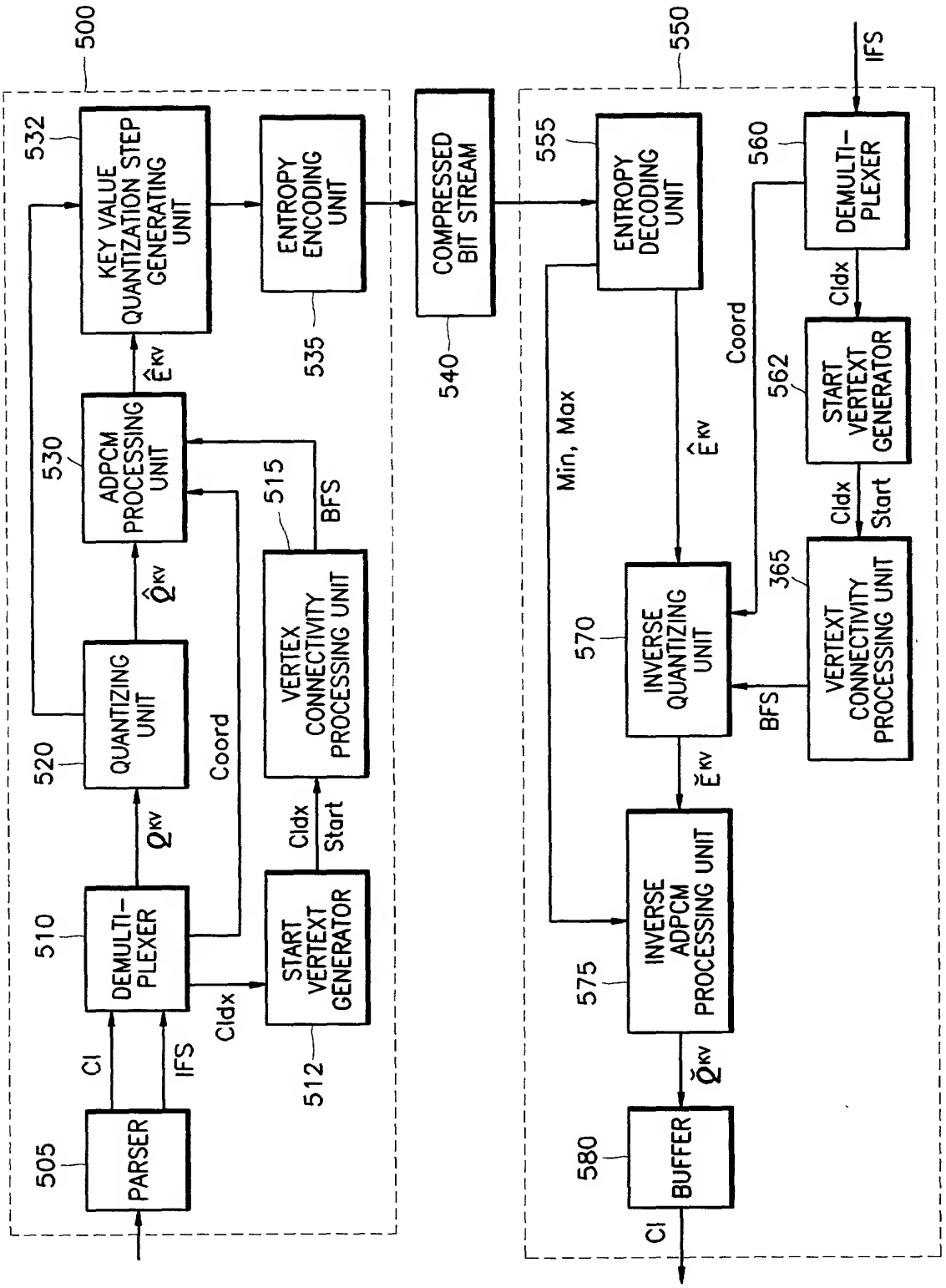

500
532
KEY VALUE QUANTIZATION STEP GENERATING UNIT
ENTROPY ENCODING UNIT
535
COMPRESSED BIT STREAM
540
530
ADPCM PROCESSING UNIT
515
BFS
520
QUANTIZING UNIT
VERTEX CONNECTIVITY PROCESSING UNIT
510
DEMULTI-PLEXER
START VERTEXT GENERATOR
512
505
PARSER
CI
IFS
Cidx
Start
Coord
550
555
ENTROPY DECODING UNIT
560
DEMULTI-PLEXER
562
START VERTEXT GENERATOR
570
INVERSE QUANTIZING UNIT
365
VERTEXT CONNECTIVITY PROCESSING UNIT
575
INVERSE ADPCM PROCESSING UNIT
580
BUFFER
Min, Max

FIG. 19

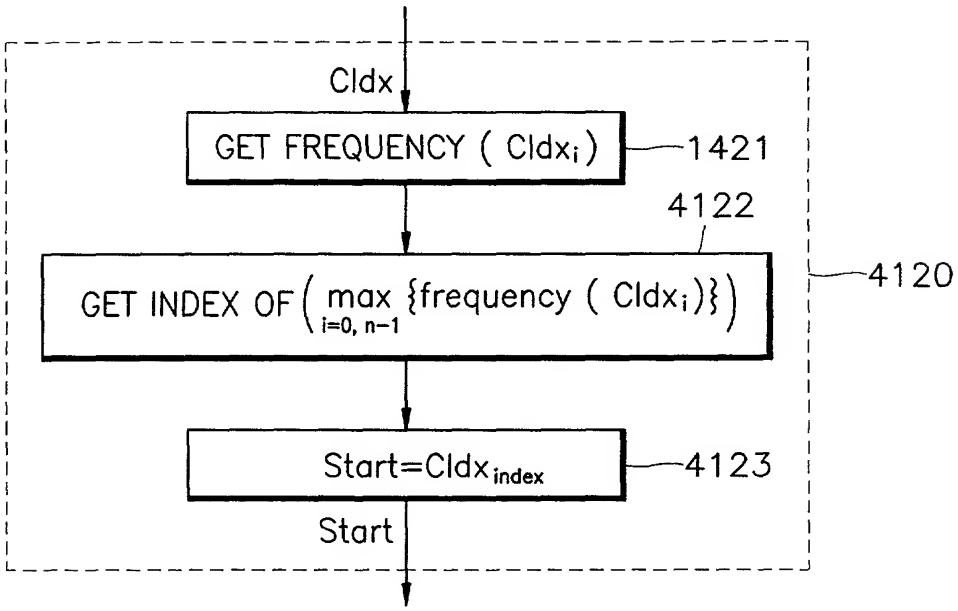

Cldx
GET FREQUENCY (Cldx$_i$)
1421
4122
GET INDEX OF (max {frequency (Cldx$_i$)})
i=0, n-1
4120
Start=Cldx$_{index}$
4123
Start

FIG. 20

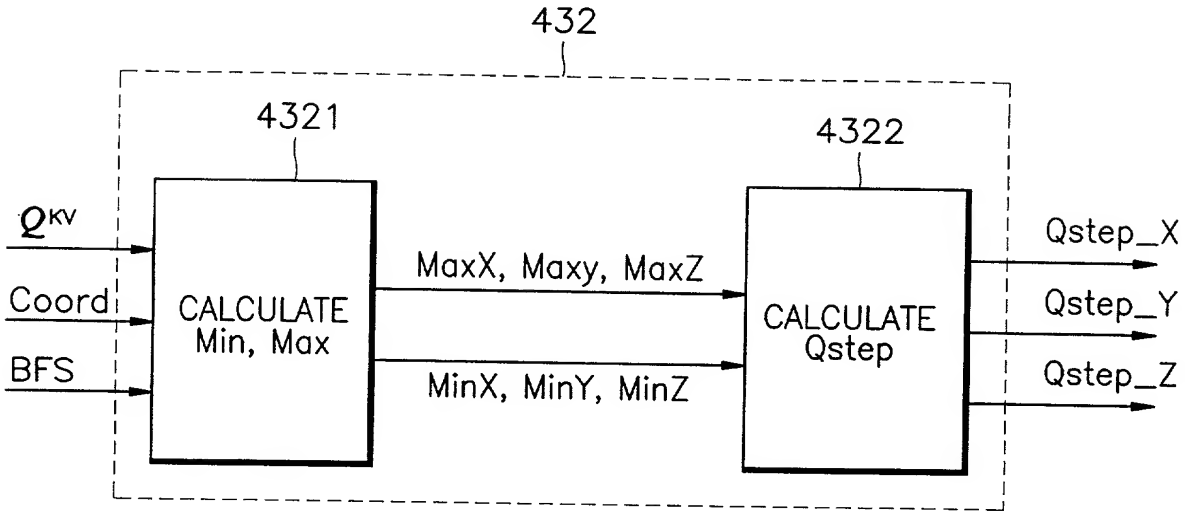

432
4321
4322
Q^{KV}
Coord
BFS
CALCULATE Min, Max
MaxX, Maxy, MaxZ
MinX, MinY, MinZ
CALCULATE Qstep
Qstep_X
Qstep_Y
Qstep_Z

FIG. 21

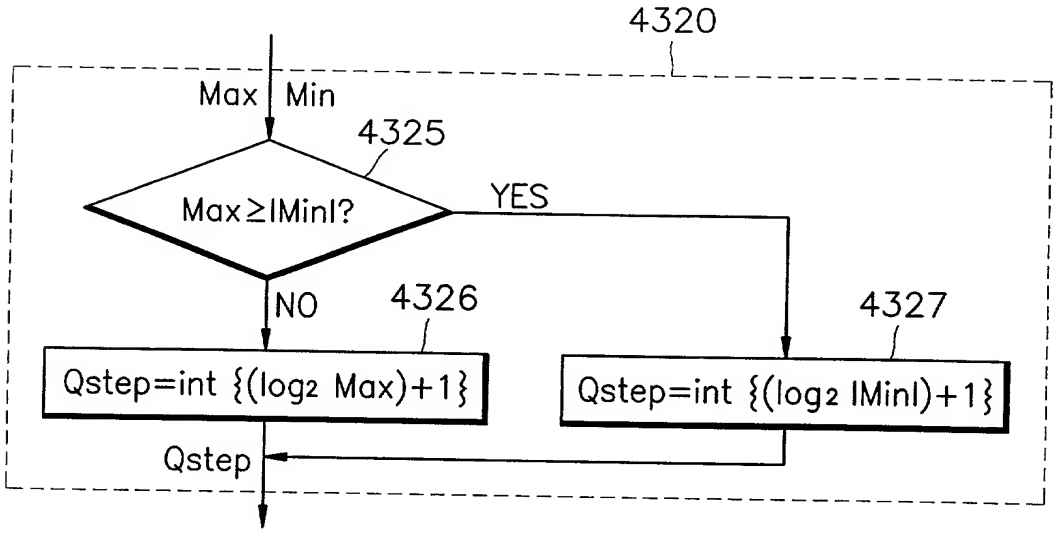
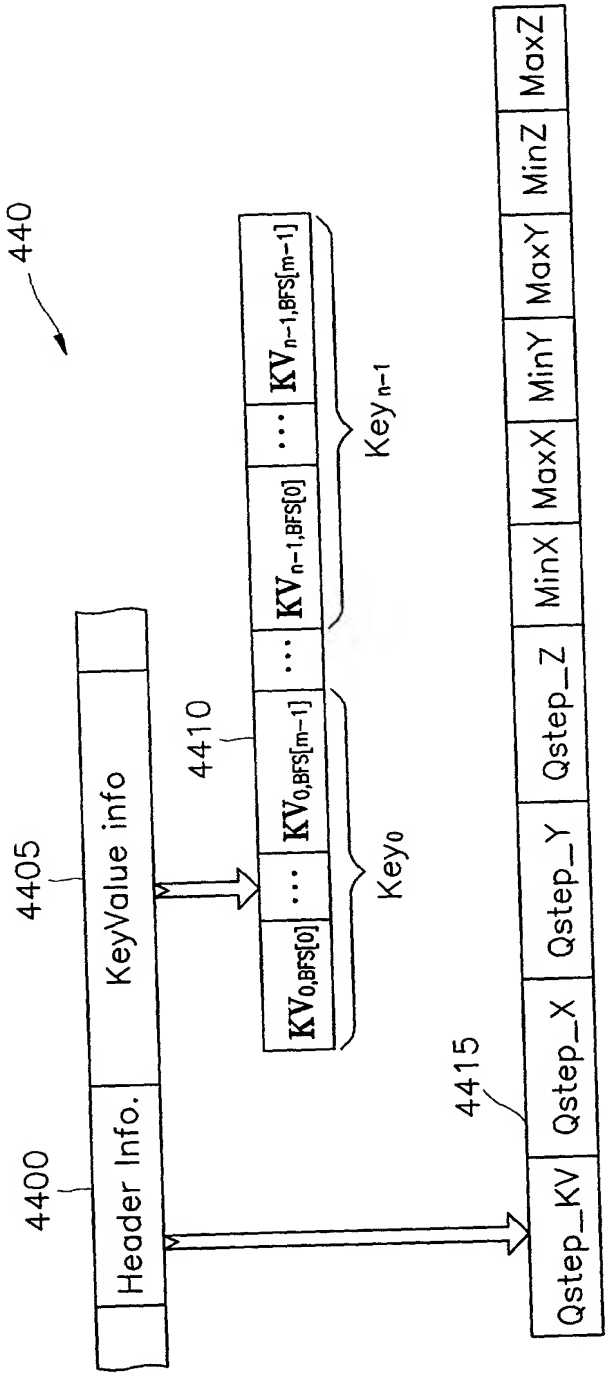

4320
Max
Min
4325
Max≥|Min|?
YES
NO
4326
4327
Qstep=int {(log2 Max)+1}
Qstep=int {(log2 |Min|)+1}
Qstep

FIG. 22


440
4400
Header Info.
4405
KeyValue info
4410
$KV_{0,BFS[0]}$
...
$KV_{0,BFS[m-1]}$
...
$KV_{n-1,BFS[0]}$
...
$KV_{n-1,BFS[m-1]}$
Key_0
Key_{n-1}
4415
Qstep_KV
Qstep_X
Qstep_Y
Qstep_Z
MinX
MaxX
MinY
MaxY
MinZ
MaxZ